Seafood Poisoning

What’s in your sushi?

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Declaration:
Conflicts of Interest

- I have nothing against seafood
- I am not related to anybody with a seafood restaurant
- I have never received payment or honoraria from fish or shellfish
Objectives

• Know some of the statistics that compel us to discuss seafood poisoning
• Know the basic types of food poisoning associated with seafood
• Know the basic syndromes of toxin-associated seafood poisoning
• Know the basic syndromes of bacterial, viral and parasitic seafood poisoning
Seafood Poisoning – why care?

• **1973-1987 (CDC) only 2.8% of foodborne illness was due to seafood.**
  – Recent figures estimate 1 in 6 due to seafood

• **70% of population lives near seacoasts**
  – Seafood provides 40% of world’s protein
  – Aquaculture production has tripled in the last 15 years, being a third of the seafood supply
  – Tourists spend 2 billion person-days/year at coastal destinations

Why care? continued

- Estimated impact of infectious disease attributable to pathogens from wastewater from land
  - 3 million DALY’s with est. economic loss of $12 billion/year

- In North America, major food safety issues are
  - Bivalve mollusk consumption
  - Ciguatera poisoning
  - Unregulated subsistence fishing

Seafood Poisoning - Types

TOXINS

Phytoplanktonic

BACTERIA

Bacterial

VIRUSES

Chemical

PARASITES
Marine intoxications: icthyotoxism

1. Scombroid fish poisoning
2. Ciguatera fish poisoning
3. Shellfish poisoning syndromes
   diarrheic, paralytic, amnesic, neurotoxic
4. Mercury poisoning
Distribution of Icthyotoxism

Figure 13.1 A world map depicting the global ranges of the most common types of toxic seafood poisonings.
Scombroid

- **Worldwide**: est’d 8000 cases/yr USA
- **Named for fish family** *Scomberidae* (tuna, mackerel, bonito, skipjack, etc.)
  - Deep water, fast swimming fish with high levels of histidine
- **Caused by bacterial breakdown of unrefrigerated fish to heat resistant vasoactive compounds**
Histidyl decarboxylase catalyzes the conversion of histidine to histamine and carbon dioxide.
Diamines

Cadaverine

\[ \text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{NH}_2 \]

Putrescine

\[ \text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{NH}_2 \]
Scombroid characteristics

- **Onset:** immediate to few hours (may taste "tingly")
- **Symptoms [initial]:** flushing, pruritus, burning, urticaria, wheezing, headache, hypotension – classic is "sunburn rash"
- **Symptoms [later]:** N/V, diarrhea
- **Treatment:** antihistamines, hydration
Ciguatera Fish Poisoning

- Due to ciguatoxin, among others
- Caused by bioaccumulation of toxins produced by *Gambierdiscus toxicus* in large reef fish
  - e.g. barracuda, grouper, snapper, sea bass
- 20-50,000 cases worldwide annually
  - Est’d 1600/yr in USA
  - In some countries as high as 1200 per 100,000
- Outbreaks associated with wholesale of imported fish (even in Canada)
Ciguatoxin
### CIGUATERA (3009 Cases)
#### Frequency of Signs and Symptoms

<table>
<thead>
<tr>
<th>Sign or Symptom</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paresthesias (extremities)</td>
<td>89.2</td>
</tr>
<tr>
<td>Paresthesias (circumoral)</td>
<td>89.1</td>
</tr>
<tr>
<td><strong>Temperature reversal</strong></td>
<td><strong>87.6+</strong></td>
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<tr>
<td>Arthalgia</td>
<td>87.5</td>
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<tr>
<td>Myalgia</td>
<td>81.5</td>
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<tr>
<td>Diarrhea</td>
<td>70.6</td>
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<tr>
<td>Headache</td>
<td>59.2</td>
</tr>
<tr>
<td>Chills</td>
<td>59</td>
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<tr>
<td>Abdominal Pain</td>
<td>46.5</td>
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<tr>
<td>Pruritus</td>
<td>44.9</td>
</tr>
<tr>
<td>Nausea</td>
<td>42.9</td>
</tr>
<tr>
<td>Vertigo</td>
<td>42.3</td>
</tr>
<tr>
<td>Ataxia</td>
<td>37.7</td>
</tr>
</tbody>
</table>
Ciguatera symptoms, cont.

- **Onset:** 6-30 hours after ingestion
- **GI symptoms:** 50-70%, cardiovascular less frequent
  - Both resolve in a few days
- **Neurological symptoms may last for weeks and recur with:**
  - Stress
  - Ingestion of alcohol, nuts, shellfish, fish
- **Mortality = 1%**
- **Management:** self-resolving, supportive treatment (no specific neurologic blockers reliably work)
Paralytic Shellfish Poisoning

- From ingestion of filter-feeding mollusks (clams, cockles, mussels, scallops)
- Tropical and temperate waters worldwide
- Filtered dinoflagellates *Alexandrium* sp and *Gymnodium breve* introduce toxins (saxitoxin derivatives) into the mollusk meat
  - Saxitoxin binds to sodium channels, blocking nerve signal transmission. Affects neurons in autonomic and peripheral nervous systems
  - Onset 30 minutes to 2 h
Saxitoxin
PSP - symptoms

- **Initial:** perioral paresthesias spreading to face and neck
- **Then:** Headache, N/V and diarrhea
- **Followed by:** (if enough toxin ingested)
  - dizziness, dysmetria, weakness
  - Dysarthria and dysphagia
  - Respiratory paralysis (leading to death)
- **Mechanical ventilation within 12 hours saves lives.** Mortality varies on availability of services, but may be as high as 70%.
“Glowing Seafood”

- Several descriptions of seafood that glows in the dark
- Not radioactive, not fluorescent (stimulated by UV light), not alien

Example – “growing seafood”

“In Seattle, Washington cooked shrimp purchased from a grocery store in 1996 startled a consumer who opened her refrigerator door. The light bulb had burned out in her refrigerator and the shrimp lit up its interior.”

Knowing about glowing

• Caused by marine bacteria, mostly
  – *Photobacterium phosphoreum/leiognathi*
  – *Vibrio fischeri/harveyi/splendidus/logei*

• Can grow at low temperatures (~4 - 20°C)
  – Require salt (grow well on shrimp, cooked crabmeat, imitation seafoods)

• Not toxic (2 exceptions: *V. cholera* bt. *albensis* and *vulnificus*)

Mercury (Hg) In Seafood

• Bioaccumulates in large fish
  – Especially albacore tuna, shark, swordfish, marlin, tilefish, etc.
  – Pike, bass, walleye (and marine mammals)

• Organic form of mercury (methyl mercury)
  – Used as fungicide, commonly present due to microbial breakdown of elemental Hg
  – Uncommon to get toxic levels unless large amounts of fish are constantly consumed

Methyl mercury (continued)

- Absorbed across intestine, distributed through body and concentrates in brain
  - Can cross placenta and accumulate in fetus
- Causes neurologic disease
  - Weakness, paresthesia, visual and auditory defects, tremor, seizures, coma or death
- Generally not at risk of toxicity, but famous cases exist, even in recent times
Methy mercury (case report)

- Dec 2008: Actor/comic Jeremy Piven leaves Broadway show “Speed the Plow” d/t mercury poisoning – dizzy, trouble lifting arms and legs, fatigue
- 20 years of sushi twice per day
- “…leaving show business to pursue a career as a thermometer”

Hill, M. Piven’s fish tale may hold water. Winnipeg Free Press (retrieved April 20, 2009).
Viral Causes of Seafood FBI

• >110 viruses in human feces, >55% of cases
• Viable in seawater, 17 mos in sediment
• Accumulate in mollusks:
  – Filter feeders: In digestive glands of oysters, clams, cockles, mussels, conch
  – Carnivorous shellfish: In inedible portions of crab and lobster
  – Survive well in coliform-free water
• Most viruses inactivated by 4-6 mins steaming
  – Main viral agents: HAV, Norovirus, (poliovirus)

Hepatitis A Virus

- Toughest viral offender: MC hepatitis due to seafood
  - Est. 4 million cases/year due to shellfish, with est. 40,000 deaths
- Takes 19 minutes steaming to inactivate, or at least 1 minute of rolling boil (~85°C)
- HAV outbreaks have been associated with consumption of oysters, clams and mussels

Practise Food Hygiene to Prevent Hepatitis A
HAV – the disease

- Incubation: 2-6 weeks after exposure
- Abrupt onset of weakness, fever, abdominal pain that may progress to jaundice (fatal <0.1%)
  - Usually asymptomatic in children
- Diagnosis: standard with a blood test for antibody to HAV (HAV IgM)
- Treatment: supportive
Norovirus (Norwalk virus)

- RNA virus with many human and animal strains – “Winter vomiting disease”
- Higher attack rate than in foodhandler associated outbreaks
- Very common cause of outbreaks, including in Canada
  - Described with oysters, clams, cockles
Norovirus (Norwalk virus), continued

- Incubation: 40 hours (12-72 hours)
- Nausea, vomiting, diarrhea, cramping
- Usually done in 48 hours (sometimes longer)
- Diagnosis: EM or PCR of stool specimens, PCR can be done on seafood
- Treatment: Supportive (no vaccine)
Bacterial seafood poisoning

- Many possibilities, but only 8% of all cases
  - Gram positive: *Listeria monocytogenes*
  - GN: *Vibrio parahemolyticus, cholera, vulnificus*
  - Rarely *Clostridium botulinum* (botulism)

- Most are transient and harmless
  - Except *V. vulnificus*, as in immunosuppressed
    it can carry a >50% mortality

Listeriosis

- **Due to psychrophilic** *L. monocytogenes*
- **Very common on surfaces of seafood, but often not virulent**
- **Incubation: 4 - 21 days**
- **Usually causes mild and short diarrhea (if anything), but in immunosuppressed can cause sepsis, meningitis, abortions**
- **Diagnosis: standard investigations of food, sometimes blood or CSF cultures**
- **Treatment: usually supportive, unless severe**
Pathogenic Vibrios

• Principal concerns are *parahemolyticus* and *vulnificus* found in oysters and crabs
• Marine (salt-requiring) Gram-negatives that like warmer waters (counts go up in summer)
• Accumulate mostly in mollusks, sometimes fish
• *V. parahemolyticus* is reported to cause up to 70% of FBI in Japan, and 35% in Taiwan
• *V. vulnificus* accounts for 90% of seafood deaths in the US, found in most oyster beds
Pathogenic Vibrios, continued

- Incubation: Vp~24 hours; Vv 1-3 days
- Vp. causes acute onset explosive diarrhea with cramping and pain. Fever, chills and headache are common.
- Vv. may cause diarrhea. It is best known for sepsis progressing to diffuse hemorrhagic bullae in immunosuppressed persons, especially those with cirrhosis or iron overload syndromes.
- Diagnosis: special culture techniques are best for isolating these salt-loving sea-dogs.
- Treatment: antimicrobials (tetracycline) and perhaps drainage are required for Vv infections.
Parasites in Seafood

- Nearly ALL marine animals are infected with some sort of parasite (so are humans)
- 50 million infected worldwide with trematodes from fish and shellfish
- Dozens of possible contenders
  - E.g. Giardia, Eustrongyloides, Paragonimus, Angiostrongylus, Opisthorchis, Echinostoma, Metorchis, Clonorchis, Nanophyetus, etc.
  - *Anisakis, Diphyllobothrium, Cryptosporidium*

Anisakis simplex (herring worm)

- Looks very similar to another occasional parasite, *Pseudoterrannova decipiens*
- Parasite of dolphins, porpoises, whales
- 3rd stage larvae in fish accidentally infect humans: herring, cod, salmon, squid, etc.
- Seen in areas where raw seafood consumption common: Japan, SE Asia, Netherlands and Spain

Anisakis continued

- Usually no symptoms
- 1-12 hours for gastric, 1-5 days for intestinal
- Acute epigastric pain, fever and diarrhea
- Sometimes allergic reaction, or “coughing a worm up”
- If penetrate intestinal mucosa, may need surgical removal
Diphyllobothrium (fish tapeworm)

- Most common cestode infection from fish
- Endemic to Canada – can reach almost 10 metres long; 13 species can infect humans
- Infects most freshwater fish and salmon, and found in gefilte fish
- Usually asymptomatic, some may have diarrhea, abdominal pain and, if *D. latum*, vitamin B$_{12}$ deficiency
- Easily treated with short course antihelmenthics
Diphyllobothrium continued

- Can grow quite rapidly
- This one grew to 4.25 m in 18 days
General Prevention

• Eat within 1-2 days of catch or purchase
• Store as close as possible to ~0-4°C
• Adhere to local advisories
• Get HAV vaccination, the full series
• “Clean, boil, peel” (or cook) or walk away
Thank You